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THE EFFECTS OF PRIMARY REWARD ON THE I.Q. PERFORMANCE OF GRADE-SCHOOL CHILDREN AS A FUNCTION OF INITIAL I.Q. LEVEL[1]

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The effect of candy reward on I.Q. scores was investigated in 72 first- and second-grade children. All subjects were administered Form A of the Peabody Picture Vocabulary Test and, based upon these scores, were divided into three blocks: low, middle, and high. From each block, subjects were randomly assigned to one of three conditions (contingent reward, noncontingent reward, or no reward) that were in effect during administration of Form B. Results showed that candy given contingent upon each correct response increased I.Q. scores for the initially low scoring subjects, but had no influence on the scores of middle and high scoring subjects.

DESCRIPTORS: IQ, scores, contingent rewards in testing, noncontingent rewards, standardized tests, children

Recent studies have pointed to the efficacy of reinforcement procedures in raising standardized test scores (Allyon and Kelly, 1972; Edlund, 1972). If test performance is viewed as a set of behaviors (Bijou, 1971) then, theoretically, test performance should be affected by reinforcement in the same way as are other behaviors. If, however, there is little transfer of learning from item to item, then the motivational level aroused by reinforcement may be the most important factor. Ayllon and Kelly (1972) identified the importance of reinforcement as a motivator in their study, and Conner and Weiss (1974) pointed out that it is unwarranted to assume that an increase in correct responses is necessarily paralleled by an increase in cognitive ability. If the effects of reinforcement in a test-taking situation are limited to a motivational function, and if all populations from which samples are drawn show the same increase in motivation, then application of reinforcement will simply shift distribution of scores upward and each subject's relative position will remain the same (Conner and Weiss, 1974).

To understand this phenomenon further, it is necessary to determine which populations will show most benefit from the motivational increases afforded by reinforcement. A comparison of two similarly designed studies suggests a tentative answer. Edlund (1972), testing a sample drawn from a population of Headstart children with a mean I.Q. score significantly below 100, obtained an increase in I.Q. scores as a function of candy reinforcement; Clingman and Fowler (1975), also using candy, failed to find a reinforcement effect in a sample drawn from a population of white middle-class children with a mean I.Q. score above 100. Clingman and Fowler (1975) hypothesized that the level of responding for their subjects was already optimal and therefore could not be significantly altered by reinforcement, whereas the initially low scores of Edlund's (1972) subjects might have been indicative of a motivational deficit that could be improved by reinforcement.

The present experiment examined this motivational factor. More specifically, this investigation compared the effects of contingent candy reward, noncontingent candy reward, and of no candy on the I.Q. scores of children whose initial scores placed them in three different I.Q. levels.

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METHOD

Subjects

Seventy-eight children, aged from 6 yr four months to 9 yr one month, were white, first- and second-graders attending a public school serving pupils from various socioeconomic classes.

Design and Procedure

Before the experiment began, it was determined which children liked candy by asking each child and the child's parents. Only when the child and the parents agreed that the child liked candy was the child retained as a subject. All subjects were administered Form A of the Peabody Picture Vocabulary Test according to standard test procedures, encouragement included. Subjects were then divided into three blocks based on initial I.Q. scores (highest third = high group, next third = middle group, and lowest third = low group) and from each block subjects were assigned to one of three reward conditions: no reward, contingent reward, or noncontingent reward. To ensure large differences between the blocks, and that each would contain a number of subjects that was a multiple of three, six subjects whose scores fell near the mean of 100 were randomly eliminated. Four weeks after Form A was administered all subjects were given Form B. Neither praise nor encouragement was given to any child in any condition during administration of Form B.

In administering Form B in the contingent-reward condition, this departure from the manual was made: each child was told: "I am going to give you an M&M candy for each right answer you give to the questions I ask. You must eat the candy when I give it to you, for you cannot take it back to the classroom with you." Priming was done by giving each child in this condition an M&M for correctly responding to each of the three sample items. Subsequently, each child was handed one M&M immediately following each correct response and the number of candies each child received was noted. No candy was given for an incorrect response. All candy was consumed immediately.

Each member in the noncontingent-reward condition was randomly paired with a subject in the contingent-reward condition according to the number of candies earned by the latter during administration of Form B. For example, if a subject in the contingent-reward condition received 30 M&Ms in this testing session, then his/her pair mate in the noncontingent-reward condition also received 30 M&Ms. Subjects in the noncontingent-reward condition were told: "I have some candy for you and I am going to put it in a bowl and you may eat it while I am asking you questions. You must finish it because you cannot take it back to your classroom." All candy was consumed in the testing session.

Subjects in the no-reward condition were given Form B in the same way as were subjects in the noncontingent-reward condition except that they were not given candy.

All testing took place just before lunch to increase the candy's effectiveness. Testing was performed by upper-division undergraduates trained to administer the test, and supervised by a clinical psychologist. Each examiner tested subjects in each condition and, to assure that the obtained differences between the first and second testing were not due to experimenter differences, the same tester administered both forms to the same child.

RESULTS

Subjects from each I.Q. level (based on Form A) were randomly assigned to three equal-sized groups ($N = 8$). An analysis of variance was then performed on the initial I.Q. scores and yielded reliable differences ($p < 0.001$) among the block means within each type of reward contingency. The Tukey HSD Test (Kirk, 1968) was used to compare the block means within each reward condition, and all pairwise comparisons among the block means were significant ($p < 0.001$). Thus, the blocks clearly represented different levels of initial scores. These data are summarized in Table 1.

Table 1

Means and standard deviations of initial I.Q. scores for each reward condition.

Initial I.Q. Level	*Reward Conditions* *Con-tingent Reward*	*Noncon-tingent Reward*	*No Reward*
High I.Q.			
X	117.2	118.5	119.9
S.D.	8.50	9.06	5.62
Medium I.Q.			
X	102.6	97.6	101.5
S.D.	6.30	8.63	6.87
Low I.Q.			
X	81.8	77.8	78.1
S.D.	9.21	11.26	12.92

The difference between each subject's Form A and Form B score was subsequently determined and became the dependent variable for a randomized blocks analysis of variance (Kirk, 1968), with Form A I.Q. being the blocking factor. The results failed to show reliable differences among the means of the three reward conditions as a main effect, $F = 2.68$, $df = 2/63$, $p > 0.05$, but the interaction of this factor with initial I.Q. was highly significant, $F = 3.92$, $df = 4/63$, $p < 0.01$.

As shown in Figure 1, this interaction was due primarily to the dramatic increase in performance by the lowest I.Q. group given contingent reward. In subsequent pairwise comparisons using Tukey's HSD Test (Kirk, 1968), it was confirmed that the cell mean of the low contingent-reward group was significantly different ($p < 0.05$) from all other cell means, except for the middle noncontingent-reward group. None of the other comparisons yielded differences that approached statistical significance. Only the low I.Q. contingent-reward group showed a change in I.Q. from Form A to Form B that was greater than one standard error of measurement based upon the test's reliability (Dunn, 1965).

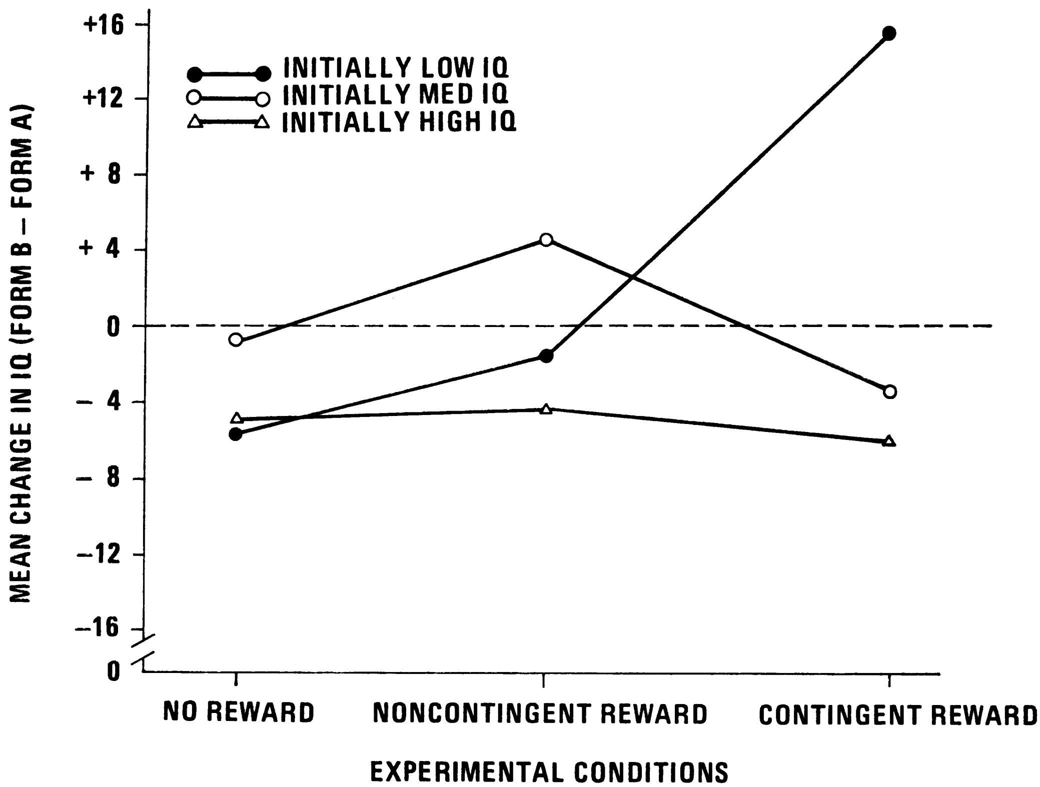

Fig. 1. Mean change in I.Q. scores for low, medium, and high groups in all reward conditions.

The number of subjects within each condition whose scores either increased, decreased, or showed no change from Form A to Form B is illustrated in Table 2: the low contingent-reward group is the only group with no negative change scores.

Table 2

Number of subjects within each condition whose scores on Form B increased, decreased, or showed no change from scores on Form A, and means and standard deviations on Form B.

Initial I.Q. Level	*Reward Conditions*		
	Contingent Reward	*Noncontingent Reward*	*No Reward*
High I.Q.			
increase	2	1	3
decrease	6	7	5
no change	0	0	0
X	111.25	114.4	114.9
S.D.	11.02	10.41	18.13
Medium I.Q.			
increase	2	6	2
decrease	6	1	5
no change	0	1	1
X	99.2	101.9	100.9
S.D.	6.67	6.29	6.64
Low I.Q.			
increase	6	4	2
decrease	0	4	6
no change	2	0	0
X	96.9	76.1	74.13
S.D.	15.85	11.26	8.46

DISCUSSION

The present results show that the consequence of candy administered contingent upon each correct response significantly increased the I.Q. scores of children from the low I.Q. group, but did not affect the scores of children from the middle and high I.Q. groups. These results help to reconcile Edlund's (1972) finding that candy given contingent upon each correct response in an I.Q. test significantly increased the scores of his subjects with an initial mean I.Q. score of 82, with Clingman and Fowler's (1975) finding that contingent candy rewards did not significantly increase the I.Q. scores of their subjects who were of above-average intelligence.

In the present study, contingent candy increased the I.Q. scores of only the "low I.Q." children. This result suggests that the high and medium I.Q. groups were already functioning at a higher motivational level than children in the low I.Q. group. Consequently, the institution of candy rewards for correct responses altered this situation by selectively increasing the motivation of the "low I.Q." children.

Unfortunately, the present study did not empirically demonstrate the effectiveness of candy as a reinforcer before making it contingent on correct responses; therefore, the alternative possibility that candy simply was not a reinforcer for the high and medium groups cannot be ruled out. On the other hand, a previous study by Tramontana (1972) showed that candy was an effective reinforcer for children of average intelligence engaged in a marble-dropping task.

If future research substantiates the notion that only certain populations benefit from reinforcement in taking standardized tests, then the use of reinforcement would not, as Conner and Weiss (1974) feared, merely increase the motivational level of all subjects, thereby shifting the distribution of scores, but would selectively enhance the performance of those children for whom correct responding is not maintained by other than external reinforcement.

To motivate test-takers, test manuals encourage examiners to give approval for effort, rather than for success (Dunn, 1965; Terman and Merrill, 1960). This procedure provides approval for incorrect as well as correct responses. Although this strategy might increase the subjects' number of responses, it probably would not affect the number of correct responses.

The question of motivation in test taking is an interesting one and needs to be pursued. If future studies, using a variety of reinforcers, or using tokens with a wide range of back-up reinforcers, yield results consistent with those of the present study, then the routine application of systematic reinforcement for all children taking standardized tests might be in order.

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